

## LINGUISTIC PERFORMANCE IN TYPICAL COGNITIVE AGING AND DEMENTIA

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### Abstract

The paper discusses studies on language in typical cognitive aging and dementia conducted on English language processing. For the most part, the studies on language in aging and dementia presented in the paper have been done with speakers of English. We describe language comprehension and production of two groups—typically aging individuals and individuals with dementia. We provide between-group comparisons with regard to language comprehension and production and point out different levels of impairment affecting comprehension and production. Moreover, taking the findings of the studies into account, which observe language impairments as secondary to motoric, although they may constitute early markers of an undiagnosed condition (Kemper et al. 1995), it is tentatively proposed that content and function words need to be given special attention in analysing language comprehension and language production, respectively. At the same time, cognitive reserve through language learning and in the case of bilingual and multilingual speakers is proposed as a strategy to delay the onset of dementia (De Bot & Maconi, 2005). Finally, we discuss elderspeak and its impact on the quality of life of typically aging individuals and individuals with dementia.

**Keywords:** dementia; aging; language comprehension; language production; content words; function words; cognitive reserve; elderspeak

1-This paper is dedicated to patients suffering from dementia and their caregivers.

### Introduction

Studies on linguistic performance in healthy and individuals suffering from a certain impairment range from large scale studies to case studies. This is a normal procedure in terms of methodology although there can be no overgeneralizations provided due to the very nature of research and the fact that people become more diverse as they age and due to the fact that language cannot be observed as a separate skill as it interacts with memory, perception and emotion (De Bot & Makoni, 2005). When it comes to linguistic aspects of three dementia syndromes (Alzheimer's disease, semantic dementia and progressive non-fluent aphasia), studies reveal that there is a significant difference in terms of language *production* deteriorating not as a cause of a cerebrovascular accident and language *comprehension*, whereas production seems to be least affected at the morphosyntactic level (Kempler & Goral, 2008). It is precisely this difference between *comprehension* and *production* as well as an increased usage of function words in both typical cognitive aging and dementia that this paper focuses on. Therefore, we first describe the linguistic aspects of typical cognitive aging and then contrast it to cognitive aging characterized by neurodegeneration in dementia.

### Theoretical framework

#### Language comprehension and production in typical cognitive aging

In terms of language comprehension at the word-level as well as the sentence-level, online studies show that it is fairly preserved in typical aging (Burke & Mackay, 1997). For example, comprehension studies that relied on lexical priming showed a comparable degree of automatic activation of the meaning of words in older and young adults (Laver & Burke, 1993). Moreover, Ratcliff et al. (2004) show that even though slower in the lexical decision task, the elderly group showed higher accuracy scores than the group with younger participants. Concerning phonological aspects, using prosodic cues during comprehension seems to be preserved in aging as well. As sensitivity for higher frequency tones declines over the life-span,

Schneider et al. (2000) assert that comprehension difficulties of the typically aging elderly seem to arise from hearing problems rather than a cognitive decline or a linguistic impairment.

Concerning language production, a number of difficulties arise which are correlated with factors such as working memory capacity and functions, education and language skills. Such age-related decline occurs in both spoken and written production (Burke & Mackay, 1997). Some studies on written language production showed lower accuracy scores in older than in younger adults in spelling tasks despite higher levels of education among older adults (Burke & Mackay, 1997). What is frequently reported as the most common symptom of typical cognitive aging are difficulties in word retrieval during spoken language production (Au et al., 1995). Burke et al. (1991) as well as Burke and Mackay (1997) suggest that lexical knowledge itself is preserved but it is the access to that knowledge that is taxing. More precisely, Burke et al. (1991) argue that the locus of retrieval deficit is not to be found at the concept level or the lemma level as conceptualization itself is not troublesome but rather at the lemma-lexeme interface—translating concepts into actual words and sentences. However, in verbal fluency tasks, the factor of age correlates strongly with education levels as higher fluency scores are found for participants with higher level of education (Kempler et al., 1998). Interestingly, studies also report a somewhat increased usage of pronouns and more difficulties in noun retrieval during language production (Burke & Mackay, 1997). This tendency for simplification is also present at the syntactic level as the elderly tend to avoid producing complex syntactic structures (Kemper, 1992). Finally, whilst speech fluency seems to be lightly affected, there are moderate to severe changes affecting phonological aspects of speech in the elderly group. More specifically, changes in the vocal tract lead to increased vocal roughness and poorer quality of the acoustic voice signal (De Bot & Makoni, 2005).

Therefore, whilst retrieving and comprehending the word meaning seems to

be rather robust in old age, age-related decline effects are observed in language production which entails mapping of a lexical concept onto a phonological or orthographic form. For the sake of comparison, the next section defines dementia and discusses important linguistic aspects of this neurodegenerative condition.

### **Language comprehension and production in dementia**

Dementia as a term may be considered a loose label for a variety of typically progressive symptoms such as memory or language deficits caused by neurodegenerative processes in the brain (see Marx, 2006; Kempler & Goral, 2008, Strandroos & Antelius, 2017). Alzheimer's disease is probably the most well-known type of dementia but there are also other types such as vascular dementia, or frontotemporal dementia that differ in impairment patterns and the distribution of the cell damage in the brain (Kempler & Goral, 2008). In this paper, we use the term *dementia* as an umbrella term for all dementia types as we are interested in discussing general linguistic aspects of dementia as described in studies rather than correlating linguistic deficits to different types of dementia which is beyond the scope of this paper.

Language production and language comprehension are observed separately in the studies conducted so far and certain conclusions have been made. In terms of comprehension, Colombo et al. (2000) showed that individuals with dementia displayed a rather intact ability to translate orthography onto phonology. However, research on how phonological aspects of language are affected in dementia is scarce. At the lexical level, just as typically aging individuals, in priming experiments, patients with dementia show automatic activation of the word meaning with somewhat larger priming effects than younger subjects as patients with dementia are generally slower (De Bot & Makoni, 2005). Nevertheless, patients with a type of dementia labelled as *semantic dementia* do show severe impairment in word recognition and processing (Rogers et al., 2006).

In terms of the syntactic level of language, Bickel et al. (2000) performed a picture-matching task and showed that the performance correlates with the degree of cognitive decline. Syntactic comprehension was spared in the early stages of dementia but progressively impaired with the progression of dementia symptoms. Bickel et al. (2000) argue that this reflects deficits in the working memory of such patients. Kempler et al. (1998), for example, showed that when the task minimized the confounding variable of working memory, patients with dementia of the Alzheimer type (DAT) were able to comprehend complex syntactic structures. Similarly, Almor et al. (2001) showed that DAT individuals' performance was comparable to those of the healthy elderly when extralinguistic factors such as working memory burdens were eliminated.

In addition to processing difficulties being directly related to working memory capacity, in a neuroimaging study (monitoring regional brain activity with fMRI (functional magnetic resonance imaging)), Grossman et al. (2002) showed that different regions of the brain are activated during comprehension in typically aging individuals and individuals with dementia. Not much is known about phonological aspects of speech in dementia, however, Croot et al. (2000) found a decline at this level of language production too and a number of articulatory difficulties. George and Mathuranath (2005) also noted an increased number of phonological errors in speech of patients with a type of dementia labelled as *progressive non-fluent aphasia*. As language production of typically aging individuals, the speech of individuals with dementia is characterized by difficulties in lexical retrieval. De Bot and Makoni (2005) suggest that at the core of this deficit is the inability to map concepts/lemmas onto lexemes and that lexical knowledge itself is preserved which is also the case with typical aging.

More precisely, performance in sentence-picture matching tasks shows no impairment which testifies to a rather preserved semantic system (Kempler & Goral, 2008). What is characteristic of the speech of individuals with dementia is verbosity which stems from a dementia-related disinhibition to suppress competing but irrelevant information (De Bot and Makoni, 2005). Kempler and Goral (2008) showed that DAT patients and patients with semantic dementia resort to using conceptually related but contextually inappropriate words, (e.g., *dog* for *horse*) which entails the loss of fine distinctions between conceptually related words.

Language production of individuals with dementia is also characterized by preference for simpler syntactic structures. This was observed in typical cognitive aging too. However, Kemper and colleagues (2001) suggest that the decrease in using syntactically complex structures is much more rapid in individuals with dementia. Chapman et al. (1998), among others, found that dementia is also characterized by progressively poorer usage of structures that achieve coherence and cohesion in speech.

Furthermore, Almor et al. (1999) demonstrated that the speech of DAT patients contained more pronouns (compared to full nouns) than the speech of healthy participants (Kempler & Goral, 2008; Burke & Mackay, 1997). Nevertheless, the morphosyntactic structure is referred to as mostly intact (Kave & Levy, 2003), at least when it comes to subject-verb agreement, in comparison to aspects of language production that we discussed above e.g., selection errors in recalling a name or remembering a word (anomia) or below-ceiling participation in picture-naming tasks, which are widely used in assessing language production in aging. This hypothesis may be related to the language acquisition process as implicit or explicit as it may be suggested that "the lexical knowledge is basically explicit knowledge in Paradis's view, while morpho-syntactic knowledge may be explicit or implicit. The vulnerability of lexical knowledge results from its explicit character" (De Bot & Maconi, 2005, p. 62).

Based on the findings presented above, linguistic impairment characteristic of typical cognitive aging is only aggravated in dementia. Whilst language comprehension seems to be spared in typically aging individuals, moderate to severe impairments characterize language comprehension in dementia. With regard to language production, impairments that apply to typical cognitive aging are also present in the speech of patients with dementia including other symptoms such as verbosity that further affect and complicate language production. Finally, in dementia, language production seems to show more impairment than language comprehension. Consequently, Kemper et al. (1995) suggest that it is precisely language abilities that may be crucial in detecting early stages of dementia. Despite their tremendous importance in detecting and describing the severity of dementia, language functions cannot be observed in isolation as it has been shown that language performance heavily depends on factors such as working memory (syntactically complex structures are difficult to process because they impose a load on the working memory), auditory and visual perception (comprehension difficulties may not be language-related but may stem from problems in the auditory and visual systems), cognitive slow-down (slower word recognition and prolonged priming effects), education (higher level of education may delay cognitive decline) and inhibition capacities (verbosity problems) (De Bot & Maconi, 2005; Kempler & Goral, 2008). Most importantly, even though all levels of language are affected to some degree, the semantic system that underlies lexical processing is most impaired in dementia particularly so in *semantic dementia* (Kempler & Goral, 2008). As pronouns seem to prevail in frequency in the language of patients suffering from dementia (as well as typically aging individuals to a certain extent) (Au et al., 1995; Baressi et al., 2000), in the next section we define content and function words and discuss the difference in the usage, focusing on patients suffering from dementia in order to make certain conclusions related to the Critical Period Hypothesis used in the present paper to illustrate the language acquisition milestones, relate them to language attrition, and suggest solutions that may assist in slowing down the process of language attrition.

### **Usage of function and content words in dementia: cues to language as evidence**

It is proposed that another perspective from which language production may be observed in patients suffering from dementia is that which gives a special attention to the usage of function words primarily and not content words. Whilst content words such as nouns, verbs, adjectives and adverbs that denote specific lexical meanings belong to open-class categories, function words such as pronouns, determiners, auxiliary verbs, modal verbs, prepositions are classified as closed class words (Quirk et al., 1985). Their number is fixed and their usage is not paid attention to when writing or reading unless the author is metalinguistically aware. According to research done in morphostylistics and forensic linguistics, their presence, especially in the written form, may reveal emotional and psychological states of the conveyor of the message. For languages that are not *pro-drop* languages, or those in which there is one explicit form for the first-person pronoun, the first-person pronoun used for conveying self-reference may be referred to as “cognitive access to oneself” (Chierchia, 1989, as cited in Jaszczolt, 2013, p. 6). Furthermore, studies have been conducted worldwide on the usage of first-person singular and plural in: private and public accounts of relationship break-ups, personal narratives on domestic abuse and the distribution of pronouns (e.g., I, you, he, she), the usage of the first- or second-person pronoun in self-talk to enhance performance (telling yourself that you have to do something and writing to-do lists), etc. (see Kalajdžisalihović, 2020). What is interesting in this approach is that a question arises whether we acquire function or content words “first”. Kempler and Golar (2008) also observed the overuse of pronouns was present in language production in dementia.

Furthermore, they report insensitivity to incorrect pronouns in language comprehension but they note that individuals with dementia react to nouns rather than pronouns when addressed. Note that this further supports

the claim we made in the previous section: language production is more impaired than language comprehension in dementia. Importantly, what this suggests is that in language production, people suffering from dementia resort to what we might refer to as “a function word one-word stage” and when it comes to language comprehension, they resort to what we might refer to as “a stage with more attention to content words”.

The phenomenon we have just described can be related to processes that unfold during language acquisition. In the case of language acquisition and the one-word stage, the child is uttering single words which might stand for whole sentences, i.e., holophrases (*sentences in embryo*, see McNeill, 1970). If we relate this process to language attrition (decline in language abilities) that characterizes dementia, then we tentatively propose that function words, e.g., *pronouns*, or even *syllables* seem to have the role of holophrases and stand for whole sentences in the cases when no sentence can be produced (e.g., a syllable standing for the whole content word denoting a name (of one’s spouse or daughter, for instance) or a sentence attempted to be generated (without success)). What is relevant for the present paper and may be an argument against the hypothesis that has just been proposed is that Pennebaker and Stone (2003) looked at a compendium of text samples from interviews with over 3,000 volunteers ranging in age from 8 to 85. They found a progressive decline in first-person singular pronouns, and a corresponding increase in first-person plural pronouns, over the course of the life-span. However, if we take into account that they analyzed text samples and not spoken language of people suffering from dementia, the argument about language production being more salient in terms of cognitive access to shorter words, i.e., function words in the case of the English language, may still be taken into consideration and in relation to coping strategies to alleviate burden in the working memory by resorting to “holophrases” of what is activated in the mental lexicon but cannot easily be retrieved either due to issues related to reduction in working memory capacity and processing or to selection issues. Moreover, it may also be

proposed that language attrition is a process opposite to that of language acquisition or that one gradually deteriorates from sentences to the two-word stage, one word-stage (where function words dominate) and finally, to syllables. For this reason, and in order to compare the findings to the theoretical framework, the theory of the critical period hypothesis and other factors relevant for understanding the relationship between language acquisition and spoken language production will be presented briefly in further text as most studies on language comprehension and production have used oral presentation of test material (De Bot & Makoni, 2005).

The Critical Period Hypothesis as proposed by Lenneberg (1967), who argued for a link between a critical period and lateralization of brain function (the proposal that language is localized to critical anatomic sites of the brain, such as Broca’s and Wernicke’s areas), suggests that humans have a window of opportunity for language acquisition between the ages of 2 and 14. After this period, the ability to master syntax is fully gone as has been the case with attic children (e.g., Genie) regardless of general intelligence. What is also interesting to mention here and in relation to language acquisition by children is that their language comprehension is ahead of their production (see references to the Cookie Monster example, Hirsh-Pasek & Golinkoff, 1996). If we observe dementia as a state similar to this window of linguistic opportunity closing, it is puzzling as to why function words feature more prominently, as earlier acquired. For instance, in the case of children who were not exposed to linguistic stimuli early enough, it is syntax that is not triggered but the possibility to learn and activate vocabulary whereas in the case of dementia patients one could propose that syntax may be activated whilst difficulties arise with content words in picture-naming tasks and lexical retrieval. In these studies, it is assumed that dementia patients were exposed to language earlier, which is why the attrition process is more likely to be compared to the deterioration from sentences to the two-word stage, the one word-stage (where function words dominate) and finally, to syllables, as mentioned earlier (see Atcheson, 2008, p. 80). However,

cognitive decline can be delayed and this can directly be correlated with an individual's cognitive reserve.

### **Bilingualism, multilingualism and cognitive reserve— multidisciplinary approaches**

In terms of the aspects of language comprehension and production, it is important to mention the term “cognitive reserve” (Bak, 2016), or particularly rich neuronal connections in the brains of individuals who have achieved high education levels and engaged in complex mental activity across the life span (Kempler & Goral, 2008). In this part of the paper, it is also proposed that such cognitive reserve “offers protection against the cognitive changes associated with the pathology of dementia” (Stern, 2002 in Kempler & Goral, 2008, p. 80) or, in other words, that bilingualism or multilingualism may act as protective variables against the cognitive changes or at least delay the onset of dementia or should it occur abruptly. At the same time, low literacy is found to affect/cause a faster decline of linguistic competences and deterioration associated with dementia (Manly et al., 2003). Furthermore, Bialystok et al. (2004) suggest that switching between two or more languages in bilingual and multilingual brains improves executive function abilities which are part of the cognitive reserve. More precisely, they showed that the onset of dementia for bilingual speakers was delayed 4.1 years on average compared to monolingual speakers despite higher levels of education of the monolingual group.

Even though bilingualism and multilingualism may act as protective variables, in different cases it has been discovered that language impairments that do occur in these speakers are either of the same type regardless of language, which corresponds to the above-mentioned proposal, or may be different for L1 that is more dominant when it comes to language switching, according to studies by Mendez et al. (1999) due to the fact that earlier learned information is more resistant to decline than later learned information (p. 411) which brings us back to the question on function and

content words and more research that needs to be done on which aspects of language or which “segments” of language are more robust when it comes to content and function words in particular. At same time, it is important to mention that in normal aging, most core language processes are robust to brain aging (Shafto & Tyler, 2014).

In summary, a plethora of studies assert that cognitive reserve postpones cognitive decline and prevents or postpones neurodegenerative changes in the brain (e.g., Bialystok et al., 2004; Perani et al., 2016 as well as many others). Perani et al. (2017) suggest that, in addition to bilingualism and multilingualism, a life-long exposure to a variety of cognitively stimulating activities, social and physical activities as well as educational achievements may contribute to building a strong cognitive reserve which helps prevent or delay dementia symptoms. Burke and Mackay (1997), therefore, conclude that since previously acquired skills and knowledge are preserved in old age, practicing and employing those previously learned skills and knowledge can maximize cognitive functioning in aging individuals. Furthermore, Burke and Mackay (1997) emphasize the tremendous importance of a regular intellectual stimulation and a continued use of language skills. Nevertheless, it is extremely important to note that resorting to oversimplified speech, *elderspeak*, in communication with elderly populations (with dementia especially) may not be beneficial to the cognitive functioning of different individuals. Elderspeak with individuals with or without dementia symptoms can be counterproductive and contribute to low self-esteem and a withdrawal from communication (De Bot & Makoni, 2005). Ryan et al. (2000) refer to elderspeak as *Communicative Predicament of Aging* that is based on the expectation of incompetence on the part of the elderly. This type of communication, consequently, sabotages any possibility of a meaningful interaction and reinforces age-related stereotypes. De Wilde and De Bot (1989) showed that elderspeak is used more intensely with more profound cognitive decline.

Gould et al. (2002), however, showed that the elderly group can have a positive attitude towards elderspeak as it eases language processing. Sachweh (1998) showed that in German nursing homes elderspeak was, to a certain extent, perceived positively which may raise the question of cultural differences too. Kitwood (1997) showed that in long-term care facilities, using language that includes negotiation (consulting the patient about their preferences which satisfies an important psychological need of control), validation (empathy and understanding), collaboration (working together, sharing tasks) and facilitation (even in the form of simplified sentential structures) is more valued by the individuals with dementia over directives whether they were overly simplified or not. Ripich and Wykle (1996) and Santo-Pietro and Ostuni (1997) also recommend concrete communicative strategies such as yes-no questions and simplified syntax without compound or complex sentences in communication with the elderly suffering from dementia.

In conclusion, even though the term *elderspeak* carries a negative connotation, using simplified language with the elderly with and without dementia can also be extremely productive. However, other factors have to be considered: the elderly must feel validated and included so that simplified language must be jargon-free, inclusive, tolerant and non-judgmental (Swaffer, 2014). Otherwise, poor communication either in nursing homes or in private settings leads to isolation and deterioration of linguistic and cognitive skills that are already declining by age and/or neurodegenerative changes. The quality of life of typically aging individuals and individuals with dementia can be drastically improved by communication, inclusion and in the case of patients with dementia, with dementia-friendly communities such as societies that will allow the authentic voice of the individuals suffering from dementia to be heard (Swaffer, 2014).

### Concluding remarks and suggestions for further research

This paper outlined characteristics of language comprehension and production in typical cognitive aging and aging characterized by neurodegenerative changes in the brain eventually leading to dementia. We showed that in typically aging individuals, language comprehension is relatively spared whilst language production is affected especially at the lexical level. In individuals with dementia both language comprehension and production were affected with production showing severe impairment. We asserted that at the core of the production impairment lie factors such as memory deficits and a progressively diminished ability to translate concepts into words and sentences.

With regard to language attrition that characterizes language processing in aging, we drew a parallel with language acquisition and raised a question if language attrition may be observed as a process opposite to language acquisition. Importantly, we outlined studies that show the effect of bilingualism, multilingualism, mental and physical stimulation on building a cognitive reserve that delays and protects against cognitive decline. Finally, we emphasized potential positive aspects of elderspeak and how language communication can improve the quality of life of typically aging individuals and individuals with dementia.

However, several important issues linger. The impact of language learning in old age on cognitive reserve, for instance, is an understudied yet tremendously important topic. Moreover, not infrequently the elderly may find themselves in nursing situations in which their language has deteriorated and where actually no one speaks their first language (mother tongue) (see De Bot and Maconi, 2005, p. 19-26). For that reason, De Bot & Maconi (2005) emphasized the importance of using adequate tests and batteries for the assessment of language in aging and dementia and their (if used) translation equivalents to patients' L1, such as *Mini Mental State Examination* (MMSE) or *Montreal Cognitive Assessment* (MOCA)

(Nasreddine et al., 2005), alongside using the Clock Drawing Test. This further means that we need to raise awareness of these problems in institutions such as nursing homes providing care to the elderly and in order to alleviate symptoms of depression and withdrawal due to there being lack of opportunity to speak, particularly in one's L1.

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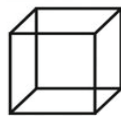
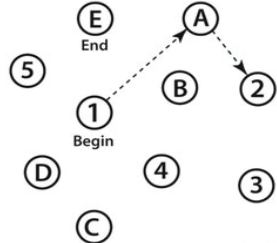

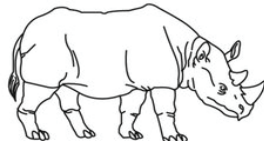
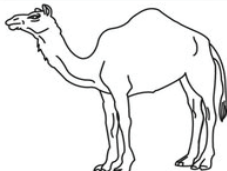
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APPENDIX

**MONTREAL COGNITIVE ASSESSMENT (MOCA)**  
Version 7.1 Original Version

NAME: \_\_\_\_\_ Education: \_\_\_\_\_ Date of birth: \_\_\_\_\_  
Sex: \_\_\_\_\_ DATE: \_\_\_\_\_

<b>VISUOSPATIAL / EXECUTIVE</b>		Copy cube 		Draw CLOCK (Ten past eleven) (3 points)		POINTS	
		[ ] [ ]		[ ] [ ] [ ]			___/5
<b>NAMING</b>		 [ ]  [ ]  [ ]				___/3	
<b>MEMORY</b>	Read list of words, subject must repeat them. Do 2 trials, even if 1st trial is successful. Do a recall after 5 minutes.	FACE	VELVET	CHURCH	DAISY	RED	No points
	1st trial						
	2nd trial						
<b>ATTENTION</b>	Read list of digits (1 digit/ sec.). Subject has to repeat them in the forward order [ ] 2 1 8 5 4 Subject has to repeat them in the backward order [ ] 7 4 2					___/2	
	Read list of letters. The subject must tap with his hand at each letter A. No points if ≥ 2 errors [ ] FBACMNAAJKLBAFAKDEAAAJAMOF AAB					___/1	
	Serial 7 subtraction starting at 100 [ ] 93 [ ] 86 [ ] 79 [ ] 72 [ ] 65 4 or 5 correct subtractions: <b>3 pts.</b> 2 or 3 correct: <b>2 pts.</b> 1 correct: <b>1 pt.</b> 0 correct: <b>0 pt</b>					___/3	
<b>LANGUAGE</b>	Repeat: I only know that John is the one to help today. [ ] The cat always hid under the couch when dogs were in the room. [ ]					___/2	
	Fluency / Name maximum number of words in one minute that begin with the letter F [ ] _____ (N ≥ 11 words)					___/1	
<b>ABSTRACTION</b>	Similarity between e.g. banana - orange = fruit [ ] train - bicycle [ ] watch - ruler					___/2	
<b>DELAYED RECALL</b>	Has to recall words WITH NO CUE	FACE	VELVET	CHURCH	DAISY	RED	Points for UNCUED recall only
	Category cue	[ ]	[ ]	[ ]	[ ]	[ ]	
<b>Optional</b>	Multiple choice cue						
<b>ORIENTATION</b>	[ ] Date [ ] Month [ ] Year [ ] Day [ ] Place [ ] City					___/6	
© Z.Nasreddine MD <a href="http://www.mocatest.org">www.mocatest.org</a> Normal ≥ 26 / 30		TOTAL				___/30	
Administered by: _____						Add 1 point if ≤ 12 yr edu	